

Loxothylacus spinulosus (Crustacea: Cirripedia: Rhizocephala) parasitising *Pilumnopus serratifrons* (Decapoda: Pilumnidae) in Moreton Bay, Queensland, Australia

Brian MORTON

Department of Zoology, The Natural History Museum, Cromwell Road, London SW7 5BD, UK.
Email: prof_bmorton@hotmail.co.uk

Jørgen LÜTZEN

Institute of Biology, University of Copenhagen. Universitetsparken 15, 2100 Copenhagen Ø, Denmark. Email: jlutzen@bi.ku.dk

Citation: Morton, B. & Lützen, J. 2008 12 01. *Loxothylacus spinulosus* (Crustacea: Cirripedia: Rhizocephala) parasitising *Pilumnopus serratifrons* (Decapoda: Pilumnidae) in Moreton Bay, Queensland, Australia. In, Davie, P.J.F. & Phillips, J.A. (Eds), Proceedings of the Thirteenth International Marine Biological Workshop, The Marine Fauna and Flora of Moreton Bay, Queensland. *Memoirs of the Queensland Museum — Nature* 54(1): 257–260. Brisbane. ISSN 0079–8835.

ABSTRACT

Seventy-eight individuals of the cryptic pilumnid crab *Pilumnopus serratifrons* inhabiting galleries in clumps of mussels (*Trichomya hirsutus*) (Mytilidae) were collected from intertidal sea grass beds seaward of Myora Springs, Moreton Bay, North Stradbroke Island, Queensland, Australia. Of the 78 crab individuals, five of the 45 males (11.1%) and 14 of the 33 females (42.4%) were parasitised by the rhizocephalan *Loxothylacus spinulosus*. No gravid females were parasitised, but the parasite appeared to restrict the size range of such females to carapace widths of between 7.5–10.0 mm. No gravid female > 10.0 mm carapace width was identified, all such individuals presumably being castrated by *L. spinulosus*. One male and four females had two parasite externas. □ *Pilumnopus serratifrons*, parasitised, rhizocephalan, *Loxothylacus spinulosus*, Moreton Bay, Australia.

The biology of rhizocephalan barnacles has been reviewed by Høeg & Lützen (1995). Parasitic rhizocephalans have a planktonic larval phase that normally involves several naupliar stages and a cyprid settling stage. Adults are internal parasites of mainly marine shrimps and crabs. The rhizocephalan life cycle is hence both complex and specialised such that the ecologies of host and parasite are highly correlated. Rhizocephalan larvae are dioecious, males being often smaller than females. The life cycle begins with the female cyprid invading a crustacean host and developing into a parasite with an internal root system (interna) that grows inside it and absorbs nutrients. Once the interna matures, it will develop a reproductive body (externa) outside the crab through the region of the abdomen. Male cyprids will then

enter the young (virgin) externa that gives rise to a fertilised externa with the eggs brooded inside it. Larvae will eventually be released via the externa.

There are few records of species of rhizocephalans parasitising decapod crustaceans in Australian waters. In Moreton Bay, however, the commercial sand crab *Portunus pelagicus* (Linnaeus, 1758) is parasitised by *Sacculina graufifera* Boschma, 1973, and has thus received particular attention (Phillips & Cannon 1978; Bishop & Cannon 1979; Weng 1987; Shields 1992; Shields & Wood 1993; Sumpton *et al.* 1994; Gaddes & Sumpton, 2004). Phillips (1978), however, described three new species of rhizocephalan from Moreton Bay. These were *Heterosaccus lunatus*, *H. multilaciniensis* and *Sacculina amplituba* parasitising the portunid crabs *Charybdis callianassa*

(Herbst, 1801), *Charybdis truncata* (Fabricius, 1798) and *Matuta granulosa* Miers, 1877, respectively. Knuckey *et al.* (1995) recorded *Loxothylacus ililei* (Boschma, 1949) infecting the commercial portunid mud crab *Scylla serrata* (Forskål, 1775) in northern Australia, but while the host is common in Moreton Bay, the parasite appears to be restricted to tropical waters. The present study concerns *Loxothylacus spinulosus* Boschma, 1928, parasitising the pilumnid crab *Pilumnopus serratifrons* (Kinahan, 1856).

MATERIAL AND METHODS

From 7–25 February 2005, visits were made during low tide periods to the sea grass (*Zostera capricorni*, *Halodule uninervis* and *Halophila ovalis*) beds down-shore from the mangrove-fringe at Myora Springs on the sheltered northwest coast of North Stradbroke Island. The principle research aim was to study a sympatric pair of galeommatid bivalves (*Varotoga* spp.) living commensally within the galleries made by the crab *Pilumnopus serratifrons* in clumps of the mussel *Trichomya hirsutus* (Lamarck, 1819), that here dot the central regions of the muddy, sea grass dominated, intertidal. This research has been separately reported upon by Morton (2008). *Pilumnopus serratifrons* was, however, noticeably parasitised by a rhizocephalan cirripede herein identified as *Loxothylacus spinulosus*. The sex of each crab was recorded and carapace widths measured to the nearest 0.5 mm using vernier calipers. The presence of either a crab egg mass or the externa of *L. spinulosus* was also noted.

The identification of rhizocephalan species is difficult and often relies upon identification of the host, as many are considered to be host-specific, as well as upon microscopic investigation of histological sections through the externa. Accordingly, two externae were removed from their hosts, sectioned longitudinally at 8 µm, and stained with Ehrlich's haematoxylin and eosin.

RESULTS

TAXONOMIC REMARKS

Loxothylacus is characterised by having the stalk and mesentery inserted at different places on the mantle (Boschma 1933: fig. 9), and the

curved male receptacles have their terminal spermatogenic components included within the ovary. Also, as may often occur in kentrogonid rhizocephalans, only one of the receptacles was producing semen.

The external mantle cuticles of the present specimens were scattered with spiny excrescences (5–6 mm), as described for *Loxothylacus spinulosus* by Boschma (1933: fig. 10). The presence of such relatively short excrescences is characteristic of *L. spinulosus* (and *L. omissus* Boschma, 1957). Most other species of the genus have longer structures often arranged in bundles, although three species, *L. scaber* (Boschma, 1931), *L. bicorniger* Boschma, 1959, and *L. engeli* Boschma, 1968, all have a smooth (or nearly so) external cuticle (Boschma 1968). Both sectioned rhizocephalans correspond in all essential characters to the two specimens of *L. spinulosus* described by Boschma (1928, 1957).

Loxothylacus spinulosus is known only from eastern Australian waters. The only two earlier records are also from *Pilumnopus serratifrons*: one from Mosman, Sydney, New South Wales, the other from an unknown locality (Boschma 1957). Two specimens originally identified as *L. spinulosus* were described from Hong Kong as infecting *Glabropilumnus seminudus* (Miers, 1884) (Boschma 1955), but subsequently described as a separate species, *L. omissus* Boschma, 1957.

BIOLOGY

A total of 78 individuals of *Pilumnopus serratifrons* was collected. Of these, five of the 45 males (11.1%) and 14 of the 33 females (42.4%) were parasitised by *Loxothylacus spinulosus*. None of the nine gravid females (27.3%) was parasitised. The mean carapace widths of parasitised male and female individuals of *P. serratifrons* were 10.0 mm and 10.3 mm respectively, as opposed to the mean widths of uninfected conspecifics that were 5.6 mm and 8.3 mm respectively. Of the five parasitised males, four had one parasite and one had two. Of the 14 parasitised females, 10 had one parasite and four had two (Table 1). Gravid females were, however, restricted to a carapace width size range of between 7.5–10.0 mm, all individuals of greater widths being parasitised and reproductively sterile, presumably as a consequence of the rhizocephalan infection.

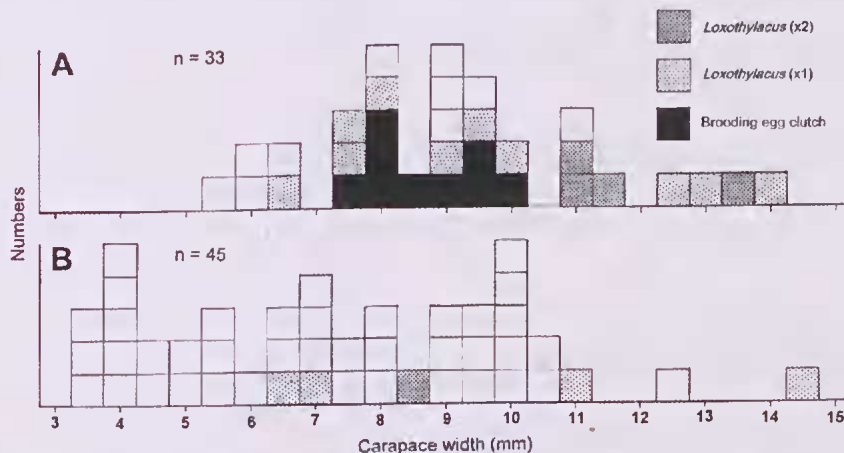
Table 1. The numbers of individuals of each sex of *Pilumnopus serratifrons* from the shore at Myora Springs, Moreton Bay, North Stradbroke Island, Queensland, infected with *Loxothylacus spinulosus*.

	Number	Mean carapace width (mm)	Range in carapace width (mm)	Mean width of unparasitised individuals (mm)	Mean width of parasitised individuals (mm)	Numbers of <i>Loxothylacus</i> (with 1 or 2) + %
Males	45	7.3	3.5–14.5	5.6	10.0	5 (4 or 1) + 8.9
Females	33	9.2	5.5–14.0	8.3	10.3	14 (10 or 4) + 42.4
Gravid females	9	8.7	7.5–10.0	-	-	-

DISCUSSION

Sacculina carcini Thompson, 1836, prefers to attack the host crab, *Carcinus maenas* (Linnaeus 1758) at the intermoult rather than the recently moulted stage (Glenner & Werner 1998). Many species of *Sacculina* are host specific, as with those described from Moreton Bay by Phillips (1978), while others are not. Thus, Liu & Lutzen (2000) have shown that in Taiwan, *Sacculina plana* Boschma, 1933, parasitises six species of grapsid crabs including the rocky shore species *Grapsus albolineatus* Lamarck, 1818, *G.* [= *Cyclograpsus*] *internueidius* De Man, 1888, and *G. longitarsis* Dana, 1851. Prevalence ranged from 13.4–71.7% in *G. albolineatus*, with males and females being generally equally infected. Thresher *et al.* (2000) showed that *Sacculina carcini* was unable to attack native crabs in its introduced

range of Australia. In contrast, Goddard *et al.* (2005) showed that *S. carcini* introduced to North America, infected native hosts, at rates ranging from 35–52%, but that the crabs arrested the infection early by melanising the rootlets of the parasite and all such infected native crabs died without producing an externa. Interestingly, in European waters where *S. carcini* is indigeneous, it may infect up to 11 crab species belonging to five genera (Høeg & Lützen 1985). Sumpton *et al.* (1994) have shown that in Moreton Bay females of *Portunus pelagicus* are more liable to infection (12.3%) by *S. granifera* than males (7.0%), although Weng (1987) obtained contrasting results for the same species. In the present study, female *Pilumnopus serratifrons* were over-ridingly selected by *Loxothylacus spinulosus* although, as for *S. granifera* parasitising *P.*

**FIG. 1:** Histograms showing the population structure (in terms of carapace widths) of A) female, and B) male *Pilumnopus serratifrons* individuals in the mussel (*Trichomya hirsutus*) clusters on the shore at Myora Springs, Moreton Bay, North Stradbroke Island, Queensland. Also identified are gravid (egg bearing) females and individuals parasitised by either one or two *Loxothylacus spinulosus* individuals.

pelagicus (Sumpton *et al.* (1994), the size distributions of infected and uninfected individuals were the same.

ACKNOWLEDGEMENTS

The senior author is grateful to Peter Davie and his colleagues at the Queensland Museum for organising the Thirteenth International Marine Biological Workshop and for inviting him to participate, and for the provision of facilities. He is also grateful to Lisa Gershwin for allowing him to use her 4-wheel drive vehicle to access the beach herein reported upon

LITERATURE CITED

- Bishop, R.K. & Cannon, L.R.G. 1979. Morbid behaviour of the commercial sand crab *Portunus pelagicus* parasitized by *Sacculina granifera* Boschma, 1973 (Cirripedia: Rhizocephala). *Journal of Fish Diseases* 2: 131-144.
- Boschma, H. 1928. The Rhizocephala of the Leiden Museum. *Zoologische Mededelingen, Leiden* 11: 146-176.
1933. The Rhizocephala in the collection of the British Museum. *Zoological Journal of the Linnean Society* 38(261): 473-552, plate 7.
1955. The described species of the family Sacculinidae. *Zoologische Verhandlungen* 27: 1-76.
1957. Notes on Rhizocephala of the genus *Loxothylacus*. *Zoologische Mededelingen, Leiden* 35(12): 153-160.
1968. *Loxothylacus engeli* nov. spec., a rhizocephalan parasite of the crab *Anasimus latus* Rathbun. *Beaufortia* 15: 21-26.
- Gaddes, S.W. & Sumpton, W.D. 2004. Distribution of barnacle epizoots of the crab *Portunus pelagicus* in the Moreton Bay region, eastern Australia. *Marine and Freshwater Research* 55: 241-248.
- Glenner, H. & Werner, M. 1998. Increased susceptibility of recently moulted *Carcinus maenas* (L.) to attack by the parasitic barnacle *Sacculina carcini* Thompson 1836. *Journal of Experimental Marine Biology and Ecology* 228: 29-33.
- Goddard, J.H.R., Torchin, M.E., Kuris, A.M. & Lafferty, K.D. 2005. Host specificity of *Sacculina carcini*, a potential biological control agent of the European green crab *Carcinus maenas* in California. *Biological Invasions* 7: 895-912.
- Høeg, J. T. & Lützen, J. 1985. Crustacea Rhizocephala. *Marine Invertebrates of Scandinavia* 6: 1-92. (Norwegian University Press: Oslo).
1995. Life cycle and reproduction in the Cirripedia Rhizocephala. *Oceanography and Marine Biology: an Annual Review* 33: 427-485.
- Knuckey, I.A., Davie, P.J.F., Cannon, L.R.G. 1995. *Loxothylacus ihlci* Boschma, (Rhizocephala) and its effects on the mud crab, *Scylla serrata* (Forsk.) in northern Australia. *Journal of Fish Diseases* 18: 389-395.
- Liu, H.-C. & Lützen, J. 2000. Asexual reproduction in *Sacculina plana* (Cirripedia: Rhizocephala), a parasite of six species of grapsid crabs from Taiwan. *Zoologische Anzeiger* 239: 277-287.
- Morton, B. 2008. The biology of sympatric species of *Scintillona* (Bivalvia: Galeommatoidea) commensal with *Pilumnopus serratifrons* (Crustacea: Decapoda) in Moreton Bay, Queensland, Australia, with a description of a new species. In, Davie, P.J.F. & Phillips, J.A. (Eds), Proceedings of The Thirteenth International Marine Biological Workshop, The Marine Fauna and Flora of Moreton Bay, Queensland. *Memoirs of the Queensland Museum - Nature* 54(1): 339-354.
- Phillips, W.J. 1978. Some parasitic barnacles (Rhizocephala: Sacculinidae) from portunid crabs in Moreton Bay, Queensland. *Memoirs of the Queensland Museum* 18: 255-263.
- Phillips, W.J. & Cannon, L.R.G. 1978. Ecological observations on the commercial sand crab, *Portunus pelagicus* (L.), and its parasite, *Sacculina granifera* Boschma, 1973 (Cirripedia: Rhizocephala). *Journal of Fish Diseases* 1: 137-149.
- Shields, J.D. 1992. Parasites and symbionts of the crab *Portunus pelagicus* from Moreton Bay, eastern Australia. *Journal of Crustacean Biology* 12: 94-100.
- Shields, J.D. & Wood, F.E.I. 1993. Impact of parasites on the reproduction and fecundity of the blue sand crab *Portunus pelagicus* from Moreton Bay, Australia. *Marine Ecology Progress Series* 92: 159-170.
- Sumpton, W.D., Potter, M.A. & Smith, G.S. 1994. Parasitism of the commercial sand crab *Portunus pelagicus* (L.) by the rhizocephalan *Sacculina granifera* Boschma, 1973 in Moreton Bay, Queensland, Australia. *Australian Journal of Marine and Freshwater Research* 45: 169-175.
- Thresher, R.E., Werner, M., Høeg, J.T., Svane, I., Glenner, H., Murphy, N.E. & Witter, C. 2000. Developing the options for managing marine pests: specificity trials on the parasitic castrator *Sacculina carcini*, against the European crab, *Carcinus maenas*, and related species. *Journal of Experimental Marine Biology and Ecology* 254: 37-51.
- Weng, H.T. 1987. The parasitic barnacle *Sacculina granifera* Boschma affecting the sand crab *Portunus pelagicus* L. in populations from two different environments in Queensland, Australia. *Journal of Fish Diseases* 10: 221-228.